SOIL SURVEY OF THE JAMESTOWN AREA, NORTH DAKOTA.

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LOCATION AND BOUNDARIES OF THE AREA.

The Jamestown area is located in the east central part of North Dakota, and comprises parts of Stutsman and Barnes counties. It is included within meridians 98° and 98° 53′ 34″ west longitude and 46° 48′ 15″ and 46° 58′ 41″ north latitude, and is made up of townships 139 and 140 north, ranges 58 to 65, inclusive, west.

The area has an extent of approximately 496 square miles, or 317,760 acres.

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

The experiences of the early settlers of the area were similar to those of all the early settlers of the Northwest. The earliest permanent settlements were made in 1871, after the Northern Pacific Rail-

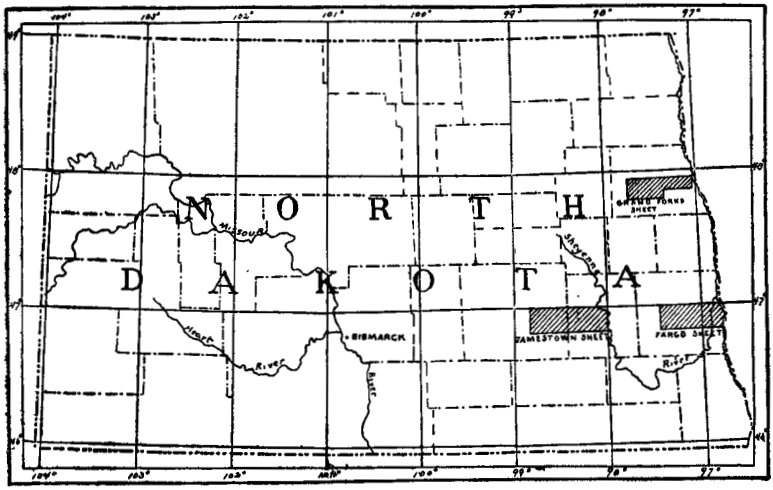

FIG. 50.—Sketch map showing location of the Jamestown area, North Dakota.

road had penetrated the region. In 1872 the city of Jamestown was founded by the railroad company. Stutsman County was organized in 1872 under the laws of Dakota Territory. The first actual settlements in Barnes County were not made until 1877, and the following year the county was organized with Valley City as the county seat. Prior to 1880 the growth of the towns was slow, on account of the embarrassment of the railroad and because of other drawbacks which

retarded the settlement of the surrounding country. The very earliest settlements were scattered and for the most part of a transient nature. The long, rigorous winters, the lack of fuel, and the blizzards of the early days were hardships hardly appreciated by those now living under the modified conditions of climate with better facilities for obtaining fuel. But from the beginning the growth of the region has been a healthy and vigorous one. The sturdy, industrious class of farmers who came from Scandinavia have done much to bring the region into prominence.

In 1887 a general immigration set into the Territory as a whole, and the location and productiveness of the area surveyed attracted its full share of newcomers. In 1889 the States of North and South Dakota were created out of Dakota Territory. From 1880 to the present time the history of the region has been one of growth and prosperity. The lands, which were either taken up under the homestead act or purchased from the railroad corporations for a nominal sum, have steadily increased in value, and during the past few years have doubled and in some cases trebled in value. In the eastern part of the area the present average price per acre is $25. In the vicinity of Jamestown the average price for the prairie soil is about one-third lower than at Valley City.

CLIMATE.

Owing to the absence of forests and the geographic position of the area, in the center of a large continent, and about equidistant between the north pole and the equator, the difference between the temperature of summer and of winter is very great. Usually there are only a few days in summer when the mercury gets as high as 100° F., and the nights are always cool. The seasons are sharply separated. Spring comes by a sudden transition in April, when the surface of the ground thaws rapidly, permitting seeding in a few days. Winter comes on by a sudden cold wave in November, when the ground freezes and stops the fall plowing.

During the months of January and February the temperature is often from 10° to 30° below zero for days at a time, but the dryness of the atmosphere makes this low temperature no more difficult to endure than a much higher temperature along the coast or lakes, where the atmosphere is damp.

There is a considerable difference in precipitation between the extreme eastern and the extreme western limits of the area. The records of the Weather Bureau station at Jamestown cover a period of twelve years, and show that the average yearly precipitation is about 18 inches. The year 1899 was an exceptional year, when the precipitation was as low as 6.75 inches. In 1896 the precipitation was also exceptional, when the records showed a total of 33.09 inches. Although

the records at Valley City are incomplete, it is pretty well established that the average yearly precipitation is about 21 inches. The chain of lakes in the vicinity of Sanborn seems to affect the conditions of precipitation, for east of these lakes the precipitation is practically the same as at Valley City, while west of them it is about the same as at Jamestown. The subsoils east of the lakes are a trifle heavier and therefore better able to retain moisture. These are facts well recognized by the farmers, and all lands east of the lake chains are held at from $5 to $10 more an acre than those to the westward. The presence of so many native trees along the Sheyenne River is also believed to have something to do with the greater precipitation.

The following table gives the normal temperature and precipitation, so far as available, from the records of the Weather Bureau stations at Jamestown and Steele:

Normal monthly and annual temperature and precipitation.

Month.	Jamestown.		Steele.		Month.	Jamestown.		Steele.	
	Temperature.	Precipitation.	Temperature.	Precipitation.		Temperature.	Precipitation.	Temperature.	Precipitation.
	° F.	*Inches.*	° F.	*Inches.*		° F.	*Inches.*	° F.	*Inches.*
January	9.0	0.53	8.0	0.32	August	67.0	1.28	66.0	2.20
February	9.0	.56	7.0	.36	September	58.0	.93	58.0	.76
March	19.0	1.00	15.0	.66	October	46.0	.53	41.0	.39
April	42.0	2.21	41.0	1.65	November	22.0	1.15	25.0	.59
May	53.0	2.98	54.0	2.44	December	16.0	.74	14.0	.24
June	65.0	4.21	63.0	3.42	Year	39.7	.....	38.3	15.79
July	70.0	.....	68.0	2.76					

The winters are less severe than formerly, the greatest change being in the months of January and February. In these months there has been a decided increase in temperature, and a slight increase in the months of March, April, and May, while during the remainder of the year the conditions have been more constant. That the winters are milder now than formerly is a fact well recognized by all farmers who have lived in the valley for a score or more of years.

Owing to the difficulty of getting onto the fields early enough in spring to plow for seeding, nearly all plowing is done in the fall after harvest, thus exposing the characteristic black soil of the region to the sun during the winter months, while in the summer months the growing and maturing crops represent more nearly the original prairie condition. This is doubtless one reason why there has not been so great an increase of temperature during the summer as in the months of January and February. The rainfall is greatest during the months when it is needed most by the growing crops, namely, in June and July. During January and February the average precipitation is less than 1 inch. The small amount of snow that falls during these months

is not lodged in the prairie grass as formerly, but is either blown off the plowed fields into the coulées or is melted upon the heat-absorbing black soil during the bright days. Before the country was broken up the snow was held in the prairie grass, the light-colored grass and lighter-colored snow tending rather to reflect the sun's rays than to absorb them. The conclusion is that the change of temperature is due to the exposure of so much black soil to the sun during the winter months.

On the whole, the length of the growing season seems to be a little longer, and therefore the conditions are getting more favorable for corn. This change may be ascribed to the same cause as the milder winters—the exposure of the black soil to the sun. While it is well known that a black soil radiates heat as rapidly at night as it absorbs it during the day, it should be remembered that in this northern latitude during the spring, summer, and fall there are more hours of sunshine per day than in latitudes farther south.

The term "killing frost" represents a frost which will kill such crops as are generally grown in the valley, and usually represents a temperature of 24° F. If fruits were grown in the valley a much higher temperature would doubtless be regarded as a killing frost.

The records for the past several years show the average dates of the last killing frost in spring and the first in fall to be as follows:

	Last in spring.	First in fall.
Jamestown	June 1	Sept. 12
Steele	May 27	Sept. 13

PHYSIOGRAPHY AND GEOLOGY.

The entire area was covered with ice during the glacial period. One can form a better idea of this period if he thinks of a great mass of ice flowing or shoving its way across the country from north to south, carrying with it large quantities of granite, gneiss, schist, and limestone from Canada, planing off the hills, and filling in the valleys with the material of the hills. This was not a condition peculiar to North Dakota, but common to the northern States from North Dakota to Maine. When this great mass of ice retreated, or thawed away, the ground-up rock fragments which had been carried along by it were left as a mantle over the glaciated region. The thickness of this mantle or glacial till, as it is commonly called, varies in different parts of the glaciated region, but in the area surveyed the average thickness is less than 100 feet.

The topography of glaciated regions varies from comparatively level to very hilly and broken. With the exception of the morainic

hills south of Sanborn the surface in this area may be classed as level prairie. It is characterized by its gently undulating surface, made up of a succession of low hills and knolls and shallow depressions, with a few glacial bowlders and some gravel strewn upon the surface and disseminated through both soil and subsoil.

From the extreme eastern to the extreme western limits of the area, a distance of 42 miles, there is a gradual rise westward of about 125 feet. This gradually rising and gently undulating prairie is broken by two deep gorges, where the James and Sheyenne rivers have cut their channels. The waters of the former stream eventually reach the Gulf of Mexico, while those of the latter flow into Hudson Bay. The divide between these two systems of drainage crosses the area at Eckelson. Jamestown, on the James River, has an altitude of 1,400 feet and is 115 feet below the top of the prairie, while Valley City, on the Sheyenne, has an altitude of 1,221 feet and is over 200 feet below the prairie. The lowest point in the area is 1,200 feet above sea level, while the highest point is on the terminal moraine south of Sanborn and has an altitude of 1,600 feet, so that there is a range in elevation of 400 feet in the area.

The James and the Sheyenne rivers are now small and sluggish, and it was during the glacial period, when they were swollen with the waters of the melting ice, that their deep gorges were cut. The bluffs along the James are made up entirely of glacial till, the underlying Cretaceous rock of the county being exposed only in the lower places along the stream. These bluffs are characterized by their serrated appearance and also by the fact that their steep sides are strewn with glacial bowlders of all sorts and sizes. The bluffs along the Sheyenne River have an entirely different appearance. Their tops are capped by only a thin mantle of glacial till. The line of separation between this till and the underlying Cretaceous shales can be traced by the difference in vegetation above and below the line. Above the line the bluffs have the appearance of those along the James, being serrated and covered with glacial bowlders, and because of the slight rainfall and too perfect conditions of drainage devoid of all vegetation except a scanty growth of grass. Below the line the numerous springs which come out on top of the Cretaceous shales furnish sufficient moisture for a natural vegetation of oak and other hardwood trees.

Between the James and the Sheyenne rivers are several dry waterways which cross the area in a north and south direction. None of these waterways are more than 40 feet deep. They are fairly well defined and doubtless served as avenues for carrying off a great deal of water from melting ice to the northward during the glacial period. Some of these old water courses are cut into the underlying Cretaceous rock, and they may represent preglacial channels that were not

so completely filled with glacial material during glacial times but that they still served to carry off the water from melting ice. Water has not flowed through these valleys within the memory of man, and they are now entirely dry, except in the depressions which are considerably below the natural avenue of drainage. Water usually collects in these depressions, and often a series of lakes may be traced along these old water courses. Such a chain consists of Fox, Rose, Grove, and Mud lakes.

The lakes mentioned above have no outlets and their waters contain a great deal of alkali. Grove and Mud lakes are very shallow and often become dry by evaporation in the summer. The alkali, which was in solution, is then left as a white deposit along the shores and dry bottoms of these lakes, but when the wet season returns these salts are again taken up. If the waters of these two lakes were drained off and the salt not allowed to accumulate, their mud bottoms would probably become valuable for the production of hay.

A characteristic of all these lakes is that they have a distinct fringe of sand, gravel, and bowlders along their shores. This was such a distinct feature, and so much ground was covered with shore bowlder-chains that it was indicated as a distinct type in the soil map. Its origin can be traced to the sand, gravel, and waterworn rocks and pebbles strewn along old water courses. The sand and gravel along the lakes is this material sorted by wave action of existing lakes, but the long line of accompanying bowlders is accounted for by a different phenomenon. During the intensely cold winters these shallow lakes freeze to their bottoms. The rocks and bowlders in the bottoms are frozen into the ice. Large cracks appear in the ice, and during the warmer days these cracks are filled with water, which freezes and expands. The result is a pushing of the ice upon the shores and the carrying of the rocks a little farther shoreward each successive winter. The finer material along the bottom is also frozen into the ice, and when the ice breaks up in the spring it is carried along in the direction of the prevailing wind. The sand and gravel thus accumulated is reworked by the waves and piled up by them, forming beaches.

SOILS.

The location of the area about midway between the lands used exclusively for grazing and those used for grain growing makes it representative of the types of soil and the conditions of climate over a very large and important part of the State.

The following chapters give a description of the soil types met with in the area, and the appended table shows the extent of each of these types and the proportion which each bears to the total area.

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Marshall loam	206,976	65.1	Meadow	4,992	1.5
Marshall silt loam	41,280	13.2	Hobart clay	3,712	1.1
Marshall stony loam	30,208	9.5	Sioux clay	2,432	.8
Riverwash	17,408	5.5	Total	317,760	.....
Sioux fine sandy loam	5,632	1.7			
Miami black clay loam	5,120	1.5			

MARSHALL STONY LOAM.

The Marshall stony loam has an average depth of about 7 inches of dark-brown, loose, sandy or gravelly loam. Occasionally there is present an admixture of considerable clay loam, and again the interstitial material may be almost wholly coarse sand. The surface soil is underlain to a great depth by unmodified glacial till. Disseminated throughout both soil and subsoil, and scattered in large quantities on the surface, are glacial bowlders of all sorts and sizes. This type is in nearly all cases associated with the abandoned waterways and with the moraines which are scattered over the entire area but are especially numerous south of Sanborn. It also occurs as narrow areas encircling Miami black clay loam. Here the soil represents beaches of old lakes or ponds.

This type is also found on the sides of all the serrated bluffs of the James River and on the sides of the deep coulees which lead into this river. Along the Sheyenne in the vicinity of Valley City and to the southward this type is found only on the tops of the bluffs, the lower parts of the bluffs being composed of the Cretaceous shales. On the river northwest of the town the glacial till has been spread as a mantle over the entire bluffs from top to bottom, and in such locations the conditions are the same as those on the sides of the bluffs of the James River.

The moraines represent places where the edge of the melting ice sheet stood for some time. The character of the material thus accumulated varies. Sometimes it is quite sandy, nearly always it is very stony, while occasionally it is very nearly the same in texture and appearance as the Marshall loam found on the level prairie, but because of the slight rainfall, and owing to its elevated position or its great porosity, it is too dry to be of any great agricultural value except as pasture.

South of Sanborn some of the morainic hills mapped as this type rise to an elevation of 200 feet above the surrounding prairie. The subsoil in some of these hills is not unlike the soil on the level prairie, but the soil on their steep slopes has been so washed that nothing but

the coarser constituents are left, the finer particles having been carried down into the valleys between the hills. Occasionally fair crops are grown about half way up the sides of some of these hills, depending upon the season and the local conditions of moisture, but considerable areas are of no value except as pasture lands.

A phase of the Marshall stony loam consists of a dark-brown or black loam, with an average depth of 20 inches, underlain by a subsoil of coarse sand or gravel. As in the type Riverwash the subsoil often persists to a great depth. Disseminated throughout the soil and subsoil are large glacial bowlders. In the soil there is usually present considerable organic matter derived from the luxuriant grasses which grow in such locations. In the lower depth of the subsoil, at about 15 feet below the surface, there is often one or two inches of bluish-gray silt or clay.

This phase is found in the bottoms of the "dry waterways" which were avenues for the water from melting ice in glacial times. It differs from the Riverwash chiefly in that the latter is found in higher locations and is dry throughout the year, and therefore of little agricultural value except as a scanty pasture. It differs from the areas mapped as Meadow in that the latter are too low and marshy to be of much agricultural value under present conditions.

In all cases the surface soil of this phase is a wash of the finer sands and silts from the higher surrounding prairie and is a veneering over the wash left at the close of the glacial period. In a few locations the lowest slopes of the typical Marshall stony loam have been veneered over by a wash from higher grounds. As in the case of the typical stony loam, there are sometimes numerous large bowlders protruding above the surface.

This phase of the Marshall stony loam, occupying as it does the lower, but not the lowest, parts of the old water courses, usually contains plenty of moisture during the greater part of the year. In times of excessive rain, however, it is usually very wet and occasionally flooded, while during the long-continued drought it may become very dry because of the loose, porous nature of the subsoil. Because of this and because in some locations there are injurious amounts of alkali, it is not a desirable soil for cultivated crops. The type seems usually well adapted to grass and pasture, and is used almost exclusively for these purposes. It would doubtless be better if no attempt were ever made to put this type under cultivation. It is now one of the most valuable types in the area for grass, and since so much of the prairie has been broken and the prairie grass destroyed there is an increasing demand for hay.

The table on the following page shows the texture of samples of the fine earth of the Marshall stony loam.

Mechanical analyses of Marshall stony loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
9159	4½ miles SW. of Eckelson.	Brown loam 0 to 8 inches.	5.27	3.82	8.22	8.16	23.56	20.42	28.42	7.38
9161	Valley City.....	Brown stony loam, 0 to 30 inches.	10.57	3.18	5.68	4.98	20.90	21.80	36.04	7.42
9162	Jamestown.....	Loam, 0 to 6 inches..	7.12	4.12	7.42	7.00	20.82	15.42	34.54	10.50
9158	2½ miles S. of Eckelson.	Brown gravelly loam, 0 to 8 inches.	3.93	2.28	8.70	10.42	28.66	15.08	22.78	12.06
9160	Subsoil of 9159....	Ligh-tbrown loam, 8 to 30 inches.	3.60	3.10	7.82	7.12	20.36	17.56	29.88	13.94
9163	Subsoil of 9162....	Sandy loam, 6 to 40 inches.	2.39	3.92	7.20	7.38	20.38	12.76	28.52	19.74

The following samples contained more than one-half per cent of calcium carbonate ($CaCO_3$); No. 9158, 15.20 per cent; No. 9160, 1.62 per cent; No. 9161, 6.30 per cent; No. 9163, 4.60 per cent.

MARSHALL SILT LOAM.

The surface soil of the Marshall silt loam consists of a dark-brown to black loam with an average depth of 10 or 12 inches. The subsoil is slightly more silty and clayey in texture and varies in color from dark brown to brown, usually becoming a yellowish brown in the lower depths.

Scattered upon the surface, and disseminated through both soil and subsoil, are fragments of rock varying in size from fine gravel to large glacial bowlders. These, however, are not so numerous as in the case of Marshall loam.

This type is typically developed on the level prairie about 200 feet above the Sheyenne River, in the vicinity of Valley City, and in its most typical phase extends back from 1½ to 3 miles on each side of the bluffs. These narrow strips represent the flood plain of the river in glacial times. In its least typical phase the soil extends several miles back from the river, but only a small part of the region east of the river was included within the area. It reaches west as far as Sanborn and Hobart lakes and to the foot of the morainic hills immediately south of these lakes. The dividing line between this type and the Marshall loam leaves the area about 2 miles northwest of Sanborn.

In its topographic features it is much more level than the Marshall loam, and in the narrow strip on each side of the Sheyenne River it is practically flat. In places immediately adjoining the river it has been considerably cut up by ravines and coulées, but the outline of the original level can be traced for miles. Back from the river some distance its topography becomes gently undulating, and is marked by a

succession of low hills and shallow depressions locally known as "bog holes."

The origin of this type is glacial, as in the case of the Marshall loam, but it differs from the latter in that the underlying Cretaceous rock is in some cases very close to the surface and has entered very largely into the composition of the soil. This accounts for its being heavier in texture than the Marshall loam.

This type retains moisture better than the Marshall loam.

For general farming purposes this soil has no equal in the area. It is all under cultivation and is held at about $30 an acre. Thirty-five bushels of wheat is not an unusual average yield. Flax, oats, and barley do comparatively well.

In some places in this type there are occasional small patches on which the grain becomes partially choked off, an effect due to the gumbo characteristic of the soil. These areas are not large enough to interfere seriously with the value of this type.

The following table shows the texture of typical samples of the fine earth of this soil:

Mechanical analyses of Marshall silt loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
9167	2 miles E. of Sanborn.	Loam, 0 to 8 inches.	7.58	2.06	8.32	8.18	27.56	15.90	31.06	6.84
9165	4 miles E. of Hobart.	Gray silty loam, 0 to 12 inches.	3.44	.12	.76	1.32	5.36	6.42	74.42	11.00
9168	Subsoil of 9167....	Loam, 8 to 40 inches.	4.04	2.86	10.80	10.24	30.08	13.16	24.56	8.22
9166	Subsoil of 9165....	Yellow silty loam, 12 to 40 inches.	3.15	.10	.32	.30	1.32	2.50	80.00	15.18

The following samples contained more than one-half per cent of calcium carbonate ($CaCO_3$): No. 9166, 14.15 per cent; No. 9168, 0.60 per cent.

SIOUX CLAY.

The soil of the Sioux clay is a black to dark-brown, or sometimes yellowish-brown, clay loam or clay, with an average depth of 18 inches. The subsoil is a grayish-brown to grayish-yellow, stiff, waxy clay loam or clay, with a depth of several feet. The difference between the soil and subsoil is that the former has more organic matter incorporated with it and is a little more sandy.

The Sioux clay is a type confined to the bottoms of the Sheyenne River, from the vicinity of Valley City southward to beyond the southern limits of the area. The soil is partly of alluvial origin and partly a wash from the Cretaceous bluffs which rise about 150 feet on

each side of the river. The residual soil formed from the weathering of the soft shale in these Cretaceous bluffs has all of the characteristics of the gumbo found in the Red River Valley. It is exceedingly slippery under foot, is very waxy and gummy, and has a peculiar greasy, oily feel. The Red River Valley gumbo is doubtless the same material carried in suspension by the glacial waters and redeposited in glacial Lake Agassiz. But there are no large bodies of this residual soil, since in its redeposition along the river it has all been more or less intimately mixed with a small amount of fine sand that has found its way down from the higher prairie. In some places the type varies from a fine friable loam to a stiff silty clay having the objectionable features of gumbo.

This type, with the exception of a few gumbo spots which bake and dry out during a dry summer, is excellent for truck farming as well as for the growing of small grain. Under the best of conditions wheat sometimes yields as much as 40 bushels per acre upon this soil. Oats and flax also do remarkably well. Only about one-half of this type is under cultivation, the remainder being occupied by a growth of oak, elm, ash, and other indigenous trees.

Where cultivated this type is used largely for growing small grain and millet. The shelter afforded by the trees would make it one of the most desirable locations in the State for growing orchard fruit and berries.

The following table shows the texture of typical samples of this soil:

Mechanical analyses of Sioux clay.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
9176	Valley City.....	Brown loam, 0 to 36 inches.	0.67	0.00	0.16	0.28	3.52	10.92	58.66	25.88
9174	5 miles S. of Valley City.	Clay loam, 0 to 12 inches.	5.23	.00	.30	.82	5.66	4.52	32.06	56.64
9175	Subsoil of 9174....	Clay loam, 12 to 40 inches.	.19	.06	.56	1.90	8.92	5.80	30.80	52.34

The following samples contained more than one-half per cent of calcium carbonate ($CaCO_3$): No. 9174, 4.55 per cent; No. 9175, 14.40 per cent; No. 9176, 8.40 per cent.

HOBART CLAY.

The Hobart clay consists of from 1 inch to 4 inches of a gray or dark-brown clay, underlain to a depth of 3 or 4 feet by heavy drab-colored clay. In the lower depths of the subsoil the clay is more or less intimately mixed with fragments of the underlying Cretaceous shale. Below the fourth foot the shale is found in various stages of disintegration, until finally the solid rock is reached. The harder

parts in the shale or such parts as are more resistant to the agencies of weathering are frequently seen strewn upon the surface. This accounts for the presence of small fragments of gypsum, "iron" shale, and calcareous and fossiliferous shale. When the soil is wet it is very adhesive and slippery under foot, and has a greasy, oily feel. In dry weather it often bakes, and growing crops are often injured in this way. In a few places along the steepest bluffs the shale has not weathered sufficiently to support any vegetation, and at such places small landslides frequently occur. In places such landslides have carried down the glacial till from above.

A peculiar feature of this type, and one which is not common on any other type in the area, is the occurrence of numerous fresh-water springs, formed by the water soaking down through the porous soils resting as a mantle upon the Cretaceous shales until the impervious clay and shale are reached, when it flows laterally and issues from the sides of the hills.

Owing to the stiff, tenacious character of the soil, and its location upon the steep sides of the bluffs, this type has very little agricultural value except as a pasture for sheep and cattle. Owing to the numerous springs it supports a good growth of pasture grass. There is a use, however, to which this type is well adapted, and that is the growth of forest trees. Wherever there is a spring on the hillside, and along every ravine which carries water, there is to be found a good growth of oak, ash, elm, and other hardwood trees. At Valley City this type is covered by such a growth.

The following table gives mechanical analyses of this type of soil:

Mechanical analyses of Hobart clay.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
9178	6½ miles S. of Valley City.	Clay, 0 to 60 inches...	0.42	0.00	0.08	0.06	0.40	1.08	19.28	79.10
9177	Valley City.....	Clay, 0 to 60 inches...	.88	.24	.54	.18	.48	.84	8.02	89.52

The following samples contained more than one-half per cent of calcium carbonate ($CaCO_3$): No. 9177, 0.78 per cent; No. 9178, 18.40 per cent.

SIOUX FINE SANDY LOAM.

The Sioux fine sandy loam consists of from 1 foot to 2 feet of very fine sandy loam of dark-brown to grayish color, resting on a subsoil of the same texture with a depth of several feet, but changing in color at about the third foot, where, out of reach of decaying organic matter, it becomes gray. The Sioux fine sandy loam is found in the James

River and Sheyenne River valleys and is of purely alluvial origin, being a wash of the finer sands of the prairie type, Marshall loam, deposited as sediment in times of high water, or when these streams stood at higher levels. In the James River Valley, in the vicinity of Jamestown, this type is closely associated with the type Riverwash, upon which the city itself is built. The latter type was deposited in glacial times when the James River was a torrent, while the type under discussion is a post-glacial deposit and overlies the former.

This soil, though quite limited in extent, is one of the most desirable in the area. Because of its location, it is usually well supplied with moisture, even in the driest season. This fact together with its fine, loose, loamy texture makes it well adapted to all farm crops of the area.

Wherever this soil is found it is under cultivation. The average yield of wheat is 25 bushels per acre, but 40 bushels is not an uncommon yield. Flax averages 20 bushels, the average yield for barley is 40 bushels, and oats sometimes yields as high as 70 bushels per acre. In the vicinity of Jamestown the soil is used extensively to supply the local demand for truck. The corn which is being acclimated to the region seems to do especially well upon this type, sometimes yielding as high as 60 bushels per acre. In the vicinity of Jamestown some alfalfa has been successfully seeded upon this soil. It is also well adapted to millet, pigeon grass, and brome grass.

In a few cases this type has been irrigated, and as it lies convenient to the rivers more of it will probably be brought under this form of cultivation in the future. The results from irrigated areas have so far been very satisfactory.

The following table gives mechanical analyses of typical samples of the soil and subsoil of this soil type:

Mechanical analyses of Sioux fine sandy loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
9140	3½ miles SE. of Jamestown.	Fine sandy loam, 0 to 15 inches.	1.21	0.10	2.92	14.74	52.04	14.00	11.70	4.10
9142	Jamestown.....	Fine sandy loam, 0 to 14 inches.	2.12	2.10	9.02	7.34	28.50	18.06	26.44	8.40
9141	Subsoil of 9140....	Fine sandy loam, 15 to 36 inches.	.87	.14	1.70	7.34	37.56	23.16	25.02	4.90
9143	Subsoil of 9142....	Fine sandy loam, 14 to 30 inches.	1.90	3.94	9.36	7.70	27.04	16.92	24.94	9.58

The following samples contained more than one-half per cent of calcium carbonate ($CaCO_3$): No. 9140, 3.99 per cent; No. 9141, 9.27 per cent.

MIAMI BLACK CLAY LOAM.

The Miami black clay loam is of a very silty or clayey texture and has an average depth of 12 inches. The color of the soil varies from dark brown to black, depending upon the amount of organic matter present and the state of its decomposition. The subsoil to a depth of 3 feet or more contains more clay than the soil and has less organic matter incorporated with it. Its color varies from dark brown to gray. A few concretions of iron oxides were found in the lower depths of the subsoil.

The Miami black clay loam is more or less widely distributed over the entire area and is found in depressions that were at one time ponds or small shallow lakes. There are usually little beaches of sand and gravel and some larger rocks around the outside of these depressions, showing that at some former time they were filled with water.

Since the first breaking up of the prairie some of these low wet places have been reclaimed and are now among the most productive lands of the area, and eventually all the remaining shallow lakes will give place to areas of this soil. Probably not more than 1 per cent of this type is under cultivation. The type is especially adapted to the growing of hay.

Since the breaking up of the original prairie and the destruction of the prairie grass, the problem of hay production has become very serious. It would be better never to put the areas mapped as Miami black clay loam under cultivation, but to reserve them as meadows.

The following table gives mechanical analyses of typical samples of this soil:

Mechanical analyses of Miami black clay loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
9154	1 mile NE. of Spiritwood.	Black clay loam, 0 to 12 inches.	8.74	0.32	4.74	6.80	13.90	12.04	45.30	16.58
9156	2 miles NE. of Eckelson.	Black silty loam, 0 to 24 inches.	3.32	.28	1.22	1.72	7.02	12.32	56.48	20.96
9157	Subsoil of 9156....	Gray silty loam, 24 to 40 inches.	3.00	.22	.64	.88	3.70	7.84	57.26	29.38
9155	Subsoil of 9154....	Silty loam, 12 to 40 inches.	4.26	.18	.52	.90	3.58	7.28	56.16	30.98

The following samples contained more than one-half per cent of calcium carbonate ($CaCO_3$): No. 9154, 2.71 per cent, No. 9155, 4.78 per cent; No. 9157, 10.40 per cent.

MARSHALL LOAM.

The soil of the Marshall loam is of brown to dark-brown color, has an average depth of 7 inches, and varies in texture from a medium fine to fine sandy loam. The first foot of the subsoil is usually of the same texture as the soil, but the material becomes somewhat heavier as the depth increases. The color of the subsoil when dry ranges from light brown in the first foot to gray in the second foot, becoming yellowish when wet. The dry subsoil heaped around the mouths of gopher and badger burrows presents an appearance not unlike that of wood ashes. Scattered upon the surface and disseminated through both soil and subsoil are fragments of rock varying from the size of a pea to large glacial bowlders.

This is the most extensive type in the area. It is typically developed east and west of Jamestown. The topography is gently undulating, marked by a succession of low hills, knolls, and shallow depressions locally known as "bog holes." In many places the latter are too wet and swampy to admit of cultivation, but since the breaking up of the prairie soil of the region many of these have become so thoroughly dried out that they are cropped with the same ease as the higher prairie soil adjoining. In several places in the area, especially in the region south of Sanborn, this type of soil is marked by morainic hills, a few of which rise to 200 feet above the adjoining prairie.

The tops of these moraines, both on account of excessive drainage and the lighter texture of the soil, are very subject to drought and hence are of little agricultural value except for pasture. The lighter texture of the soil is due to the fact that the finer particles have been washed down to lower lying lands. This same fact accounts for the heavier phase of Marshall loam in the depressions between the morainic hills. The fact that nearly the whole area is a region of little definite drainage is very beneficial because the rain, instead of being carried off by streams and coulées, is allowed to soak into the ground. Along the James River and Ten Mile Coulee, east of Jamestown, the evil effects of too perfect conditions of drainage in a region of slight rainfall are plainly apparent. For a distance of from one-half mile to 2 miles on each side of these streams the type under discussion is so dry as to be almost worthless except as pasture, supporting only a scanty growth of wild grasses.

South and west of Jamestown only about one-half the area of this soil has ever been cultivated, while farther east it is nearly all under cultivation. The unbroken areas are covered with a dense sod of very nutritious natural prairie grass. In the depressions, where the conditions of moisture are better, this prairie grass grows very luxuriantly, and is very valuable for hay. In those parts of the area where this type is all under cultivation the need of prairie hay is being sorely

felt, and millet is being quite extensively grown to supply the deficiency.

Wheat, flax, oats, and barley are the leading crops, and to these this soil, in a favorable season, is well adapted. In good years wheat gives an average yield of 20 bushels per acre, but under the most favorable conditions it sometimes gives as much as 35 bushels. The average yield of flaxseed is about 15 bushels, but this crop has been known to yield as much as 25 bushels per acre. The average yield per acre of barley is about 30 bushels and that of oats about 45 bushels. A variety of corn is being acclimated to the type, and with a fair amount of rain and a season of ordinary length promising results are obtained.

The following table gives mechanical analyses of typical samples of fine earth of this soil:

Mechanical analyses of Marshall loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
9148	1 mile S. of Eckelson.	Fine sandy loam, 0 to 12 inches.	3.94	0.88	2.30	2.16	6.60	10.50	62.72	14.50
9150	5 miles E. of Spiritwood.	Fine sandy loam, 0 to 14 inches.	3.32	1.94	5.96	6.12	15.80	13.50	41.04	15.08
9149	Subsoil of 9148....	Fine sandy loam, 12 to 40 inches.	.64	6.14	9.62	7.44	18.18	12.02	29.58	16.74
9151	Subsoil of 9150....	Fine sandy loam, 14 to 36 inches.	1.90	2.50	6.70	5.58	12.06	12.68	39.92	19.42

The following samples contained more than one-half per cent of calcium carbonate ($CaCO_3$): No. 9149, 18.60 per cent; No. 9151, 12.97 per cent.

RIVERWASH.

The Riverwash consists of about 12 inches of brown or grayish-brown sandy loam underlain with coarse sand and gravel, loose shale, and large shale bowlders, often to a depth of 50 feet. The soil is merely a wash of fine sand from adjoining bluffs and prairies, and is a veneer over the coarse, loose, porous sand and gravel which underlies it. The subsoil consists entirely of a collection of coarse sand and gravel in the protected places along the streams when these were glacial torrents. For example, the coarse sand and gravel upon which the city of Jamestown is built was deposited on the inner bend of the river at that point. The same cause is assigned for the accumulation of the great quantities of sand and gravel in the vicinity of Valley City.

This type is also found in various parts of the area between the

James and the Sheyenne rivers. It is here associated with old waterways, probably unused since glacial times.

The type is locally known as "second bench land" and except for pasture is held in low esteem for agricultural purposes. In some places it is so dry that it does not furnish sufficient grass even for pasture.

MEADOW.

The areas mapped as Meadow represent a condition of low, marshy depressions found in the lowest portions of the valleys outside of the James and Sheyenne valleys. The reason that no such conditions exist along the courses of these streams is that their system of drainage is well established and there are no marshy depressions adjoining them. The type Meadow is found most extensively along the "dry waterways" in the region between the James and the Sheyenne rivers and represents a condition where no definite system of drainage has been established since the retreat of the ice sheet.

The Meadow is closely associated with the types Riverwash and Marshall stony loam, since they are all found along abandoned water courses; but it differs from the Riverwash in that the latter is higher and looser in texture and, therefore, too thoroughly drained, and from the deeper phase of the Marshall stony loam in that the latter type is a little higher and adapted to the production of hay and for pasturage.

The areas mapped as Meadow support only the coarsest and rankest kind of marsh grass, which has no value whatever as hay and very little as a pasture feed. Under the present conditions these areas have no agricultural value except as watering places for stock, and often the water is too alkaline for that purpose. In most locations the conditions would be greatly improved by artificial drainage.

AGRICULTURAL METHODS.

The early settlers who came from the East found conditions in the Northwest very different from those they left. In the area surveyed, and in the adjoining prairie region, there were no forests to be cleared and no rocks to be gathered. The pioneer had simply to build his sod house and barn, both of which were sometimes under the same roof, turn up the rich virgin soil of the prairie, and sow his seed.

The first "breaking" of the prairie sod was always shallow and with a single plow. The work of breaking began as early in the spring as possible and extended into July and August. The virgin sod is so tough that only the single plow can be used. The shallower the plowing the better, provided the grass roots are cut just below the main root. During the summer months the sod becomes thoroughly rotted and pulverizes readily when the ground is turned again in the fall. Fall plowing begins about the middle of August and continues until

frost. The next spring, as soon as possible, wheat is sown with a seeder and this is followed by a smoothing harrow. Flax is the only crop ever sown in the spring after the first plowing, because it is then too late for wheat or other small grain. Because of the fungus disease popularly known as flax wilt, flax is seldom sown upon any but new land and then only for a year or two.

After the prairie has once been broken all plowing is done in the fall. This is usually done with a gang plow, turning two furrows at a time. In order to fill the air spaces and thus prevent the furrow slices from drying out, the plow is sometimes followed by a smoothing harrow, and sometimes the plow has a harrow attachment, thus doing all the work at once. The ground is harrowed once in the spring before drilling. Wheat is sown as the first crop in the rotation. It is followed by barley, and then by oats. The most successful farmers let the lands lie fallow during the fourth summer, bringing up at that plowing an inch or so of the new soil. In this way the new soil is acted upon by the weather and also by the soil bacteria during the summer and winter months. Some cultivated crop like corn is considered nearly equivalent to summer fallowing.

As yet no commercial fertilizer has ever been used in the area, and until recently many farmers have drawn their manure out in piles and burned it, believing it to be more injurious than beneficial to the soil. In the early days it had a tendency to make the growth of straw too rank, but since the productiveness of the soil has declined through constant cropping, manure has been found to have a decidedly beneficial effect. When coarse manure is turned under it has a tendency to make the soil too dry, and the manure is often drawn out in piles and allowed to rot and disintegrate before using. One popular method is to spread it upon the ground after the fall plowing and allow it to leach into the soil during the winter and spring months. Before seeding the coarse litter is sometimes raked up into piles and burned.

AGRICULTURAL CONDITIONS.

The value of the soils of the area in the production of wheat, flax, and other crops is shown by the prosperity of the farming class. Until recently the thoughts of the farmers were taken up with the acquiring of land. This accomplished and a few successful crops harvested, they have turned their attention to improving the land and beautifying the home. The sod house and barn of pioneer days have been replaced by wood and stone structures, and most of those who have been in the area for any length of time have built for themselves good, substantial houses. As yet there are only a few large barns in the area, which may be accounted for by the practice of thrashing directly from the field and taking the grain at once from the machine to the elevators or cars. The necessity of large barns and sheds,

however, is felt wherever stock raising is carried on as an auxiliary to grain growing. One thing which has retarded the building of large barns has been the high price of building material, nearly all of which must be brought long distances from the States of Oregon and Washington.

Ten years ago the unbroken prairie land could be purchased for $7 an acre. At that price some paid for their farms with the profits of a single crop. And all those who availed themselves of the opportunity to purchase, if they have been industrious and economical, have now a good bank account and a farm clear of incumbrance, with ample stock and machinery for carrying on all farm operations.

Since then land values have been increasing, and without any additional expense on the farmer's part the value of the farms has in nearly all cases doubled and in some cases trebled. Nearly all the land in the eastern part of the area has more than doubled in value, and at present the average price is about $25 an acre. In the western part of the area, in the vicinity of Jamestown, only about one-half of the prairie has been successfully put under cultivation, and the prices range from $10 to $20 an acre, depending upon the nearness of the farms to Jamestown, or on their adaptability to the crops of the region. The days of unlimited range have ended, because the country is so thickly settled, but there are still many cattle grazing upon the prairie west of Jamestown. The land values in the western part of the area have also doubled and in some cases trebled during the past ten years, and in the future there is bound to be a continued increase in the value of agricultural lands throughout the region.

The farms of the area are nearly all operated by the owners. Those worked by tenants are rented for periods of from one to three years. It is not usual for a man of industry and economy to work as a tenant for more than three years, because by this time he is usually able to take up a quarter section in his own name. In a locality like the morainic hills southeast of Sanborn where the farms are rented to tenants year after year, it is usually an indication that the lands are undesirable for growing crops. In consideration for the use of his land the owner receives a share of the crop. The proportion is usually one-half of the crop where the owner furnishes half the seed and pays one-half the thrashing bill. Owing to the uncertainty of the seasons, either from drought, hail, or frost, it is very unusual for the tenant to pay cash rent, preferring to take the chances of getting a reasonable profit for his labor from a half crop. In prosperous times the owner usually prefers to operate his own land, because the profits are so great, and a general desire on the part of owners to rent their farms usually indicates either a series of unfavorable years or inferior land.

The size of the farms varies from 160 to about 2,000 acres, the average size being 320 acres. Smaller farms than these do not contain

enough pasture for stock, and for the ordinary man a larger farm than half a section makes it necessary to hire so much help that the profits are destroyed. The prosperity of Jamestown and Valley City and the small intervening towns is in no small part due to the fact that there are no such large farms as in the Red River Valley, and that the farmer instead of bending all his energies to seeding the largest possible area, devotes more time to a better preparation of the soil. Under this system the profits in any one year may not be so large, but they are more certain.

Although the average size of the farms in the area is only 320 acres, there is a tendency toward still smaller holdings and better methods. In the western part of the area, where the rainfall is less than in the eastern part, and where, also, the soils are lighter, the most successful farmers have learned that they must combine stock raising with general farming if they are to avoid failure in unfavorable years. Where stock is kept and good use is made of the manure much better crops are produced.

The labor problem becomes a very difficult one to solve in some years, especially when the farmer owns so much land that he is obliged to hire a great deal of help to handle the crops. During ordinary seasons the demand for day laborers is met by the large force of men who come into the State from all parts of the east and especially from the nearby eastern States. But in years of exceptional yields the demand for men is greater than the supply and under such circumstances the wage of labor becomes almost prohibitive. Since these men remain in the State for but a few weeks, at most, they often take little interest in their work and their general efficiency is low. The average rate of wage paid to harvest hands for the last five years is about $1.75 a day. The average for the past two years is $2.25. Occasionally $2.50 is paid, but this is not usual. The tendency is toward still higher wages, and since the price of farm products has gone down the farmer can not afford to hire. This is having a salutary effect upon the prosperity of the county. The farmer is learning that it is never profitable to have more land than he and his family can work, or at least no more than he and one man hired by the year can work. The usual wage by the year is $30 per month, with board and lodging in addition.

Owing to the severity of climate no winter wheat is grown. Macaroni wheat has been introduced, and though it commands a price considerably below that of other wheat, the fact that it yields about a third more is making it popular. Since recent experiments have demonstrated the value of the bread made from this wheat, strong influence has been brought to bear upon grain dealers to recognize its value, and it bids fair soon to become an important rival of the older varieties of wheat.

Flax has always been one of the important crops of the area, standing next to wheat. As yet the farmers have not had as serious trouble with flax wilt as have the farmers in the Red River Valley. However, it is well recognized that flax is a crop very exhausting to the soil, and that it will never do to crop with flax continuously for more than two years in succession.

Oats and barley are among the profitable grain crops of the area. As yet only a small quantity of corn is grown. The principal difficulty with this crop is that the season is not quite long enough. The variety grown is a small, inferior kind, but by careful selection of seed and breeding much has been accomplished toward getting a variety better in quality and better adapted to the short, cool growing season.

From the appearance of sugar beets seen in gardens it would seem that this crop might be added to the products of the area, but the practicability of establishing this industry on a commercial scale should be proved by ample experiments both in growing beets and in determining their sugar content.

As yet but a few tame grasses have been grown in the area, and since so much of the prairie grass lands has been brought under cultivation the problem of hay production is becoming very serious. Brome grass has been sown by some with a fair degree of success and with utter failure by others. The experiments with it seem to show that with careful preparation of the soil it will become a valuable grass for the region. Alfalfa has been seeded on one farm in the area, but the experiment has not been under way long enough to decide definitely how profitable a crop it will prove to be. So far it would seem that it can be successfully grown. The native hay grown in the sloughs and marshes is tall and coarse, though if not allowed to become too ripe it is very nutritious and makes excellent feed for both cattle and horses. That produced upon the higher and drier soil is fine and short and is considered somewhat poorer in quality than the product of the lowlands. The average price for unbaled hay is about $5 a ton. Millet is grown quite extensively for hay. The quality is good, but it is used almost entirely for cattle, not being considered a desirable feed for horses. Potatoes are grown for local consumption. In quality and size they are scarcely excelled by those grown anywhere. The average yield is about 150 bushels per acre. No potatoes are shipped out of the area because of the great distance to markets.

Owing to the constant demand for grain, the farmers of this section are always sure of a ready market for their crop. Two gristmills, one at Valley City and the other at Jamestown, together consume more than as much wheat as is grown within the area surveyed. Yet not all of the wheat is sold to these mills. The numerous elevators along the railroads, by their active competition with the mills, cause large quantities of wheat to find a market at the mills in Minneapolis,

St. Paul, Duluth, or Superior. Later in the season it becomes necessary to ship in wheat to keep the home mills running. During the season of 1903 the Valley City mill alone was compelled to import 110,000 bushels. A conservative estimate of the amount of wheat that will be ground by the two mills during the season of 1903 is 1,000,000 bushels. About one-half of the flour is sold within the borders of the State, one-third of the remainder in the Western States, and the remaining amount largely in Boston, whence much of it is exported to the British markets. A great deal of the barley is used for malting purposes and is disposed of chiefly in the near-by eastern cities. The flax is sold in Russia and the oats, of which large quantities are grown, are nearly all consumed on the farms where they are produced, or within the towns in the area.

Situated along the main line of the Northern Pacific Railroad, the area is in direct communication with both the eastern and western markets. From the East this road brings in immense quantities of farm machinery, while from the State of Washington it serves as a direct route for the importation of the building material so necessary to the development of this treeless region. The Minneapolis, St. Paul and Sault Ste. Marie Railroad, passing through Valley City, forms a second direct line to Minneapolis and St. Paul and joins the area with the grain belt of the great Northwest. These two lines, by their close competition, give the region excellent transportation facilities in both their freight and passenger departments. From Sanborn a branch of the Northern Pacific Railroad extends through a fertile region to McHenry, about 50 miles to the north. Another branch of more importance crosses the main line of the Northern Pacific Railroad at Jamestown, connecting on the north with the Minneapolis, St. Paul and Sault Ste. Marie line and the Great Northern Railroad, and on the south with branches of these same roads.

Along each of these lines are frequent grain stations, with elevators, which give the farmers excellent storage facilities with a minimum amount of handling. Besides the advantage accruing from good storage facilities at these elevators, the farmer has the satisfaction of seeing his grain graded before it leaves his own hands. From Eldridge to Valley City, a distance of 42 miles, there are nine of these stations where elevators are located. A few of the farmers load their grain directly into the cars on their own responsibility, and while the practice saves the expense of storage it has the disadvantages of delaying the grading until after shipment and of placing all risk of loss by leakage on the shipper.

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U.S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

SOIL MAP
NORTH DAKOTA
JAMESTOWN SHEET

AGRICULTURAL AND ECONOMIC SURVEY OF NORTH DAKOTA
DANIEL R. WILLARD, DIRECTOR

SOIL PROFILE
(3 feet deep)

Marshall loam — Sac, Sac f
Sioux fine sandy loam — Sac, Sac f
Marshall silt loam — Sic
Marshall stony loam — Sc, Sc f
Sioux clay — C
Mixed black clay loam — Sac, Sac
Hobart clay — C
Meadow
Riverwash — Sac, Sac f

LEGEND

Sac Fine sandy loam
Sc Loam
Sc f Stone and gravel
Sac Clay loam
C Clay
Sic Silt loam

Soils surveyed by
Thos. A. Caine and A. E. Kocher
1903

BASE MAP ENLARGED AND REDRAWN FROM
U.S. GEOLOGICAL SURVEY SHEET
EDITIONS OF 1896-7.

Scale 1 inch = 1 mile

Field Operations
Bureau of Soils
1903.

LEGEND

Mi Marshall loam
Ss Sioux fine sandy loam
Msl Marshall silt loam
Ms Marshall stony loam
Sc Sioux clay
Mc Mixed black clay loam
Hc Hobart clay
M Meadow
R Riverwash